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# The Costs of Consumption Smoothing: Less Schooling and Less Nutrition \*

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## Abstract

Using novel micro data, we explore lifecycle consumption in Sub-Saharan Africa (SSA). We find that households' ability to smooth consumption over the lifecycle is large, particularly, in rural areas. Consumption in old age is sustained by shifting to self-farmed staple food, as opposed to traditional savings mechanisms or food gifts. This smoothing strategy indicates two important costs. The first cost is a loss of human capital as children seem to be diverted away from school and into producing self-farmed food. Second, a diet largely concentrated in staple food (e.g., maize in Malawi) in old age results in a loss of nutritional quality for households headed by the elderly.

Keywords: Consumption, Smoothing, Lifecycle, Self-Farming, Schooling, Nutrition, Sub-Saharan Africa

*JEL* Classification: E21, O11, R20

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# 1 Introduction

In economies where large populations live on less than one dollar per day, how much can households smooth consumption over the lifecycle? While a lot of attention has been drawn to the testing of the informal arrangements that preserve consumption in response to income shocks (i.e., unanticipated income changes) in poor countries ([Townsend, 1994](#), [Attanasio and Ríos-Rull, 2000](#), [Kinnan, 2014](#)), less is known about the ability to smooth consumption against anticipated changes in income such as the arrival of old age. This is particularly important for poor countries where the lack of a pension system goes hand in hand with the presence of savings constraints ([Dupas and Robinson, 2013a,b](#), [Brune et al., 2015](#)) and with a low ability to accumulate wealth over the lifecycle ([De Magalhães and Santaaulàlia-Llopis, 2018](#)). This can limit the ability to sustain consumption in old age. To assess this question, we draw on the new waves of the Integrated Surveys on Agriculture under the Living Standards Measurement Study (LSMS-ISA) in Sub-Saharan Africa (SSA).<sup>1</sup> We focus on some of the world poorest countries in SSA, mainly Malawi, where lifecycle consumption smoothing can be a strong challenge.<sup>2</sup> Three main empirical findings emerge from our analysis.

Our first finding is that the household's ability to smooth consumption over the lifecycle is large in SSA, particularly in rural areas. For the purpose of this paper we define consumption smoothing over the lifecycle as holding marginal utilities relatively constant across stages of life ([Browning and Crossley, 2001](#)). Household expenditure displays a hump shape over the lifecycle in both urban and rural areas, but the hump is much less pronounced in rural areas. This implies a larger ability to smooth lifecycle consumption in rural areas than in urban areas. The difference between urban and rural expenditure profiles also holds once we control for household structure. Precisely, the size of the adult-equivalent expenditure hump for urban areas is roughly double that for rural areas. Further, disaggregating lifecycle expenditure we find that food expenditure is twice smoother over the lifecycle than nonfood expenditure which, given the larger share of food in household expenditure in rural areas, partly explains the flatter profile of household expenditure in rural areas than in urban areas.

The presence of a hump in lifecycle expenditure in SSA is consistent with previous evi-

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<sup>1</sup>For a detailed analysis on the LSMS-ISA improvements on previous LSMS data sets, see [Carletto et al. \(2010\)](#) and [Beegle et al. \(2012\)](#). The ISA data is available for several countries in SSA.

<sup>2</sup>We mainly focus on Malawi in the main text, the country with the highest quality of data in the LSMS-ISA group ([De Magalhães and Santaaulàlia-Llopis, 2018](#)). We show robustness of our results for Uganda and Nigeria in the online Appendix. Malawi's average income per capita of \$850, Uganda is closer to the middle of the income distribution with an income per capita of \$1,230, and Nigeria is somewhat richer with an income per capita of \$2,160. These values are in purchasing power parity for 2010 as provided by the World Bank. Using US current dollars (USD), rural households in these countries have income per capita levels of less than \$250 ([De Magalhães and Santaaulàlia-Llopis, 2018](#)).

dence from rich and middle-income countries ([Deaton and Paxson, 1994](#), [Attanasio et al., 1999](#), [Storesletten et al., 2004](#), [Fernández-Villaverde and Krueger, 2007](#)). Interestingly, the size of the hump in household expenditure in the urban areas of SSA is comparable to the U.S. This implies that lifecycle consumption is smoother in the rural areas of SSA, where the vast majority of the population lives, than in the U.S.<sup>3</sup>

Our second finding is that the smoothing of food expenditure is driven by substituting into self-farmed staple food (e.g., maize in Malawi) and away from purchased food in old age.<sup>4</sup> Food gifts play a minor role in lifecycle smoothing as they are flat throughout. These findings lessen the role of traditional lifecycle savings and sharing networks as explanations of how consumption smoothing is achieved in old age in the poor countries that we study. First, the decline in purchased food in old age together with a low ability to accumulate wealth and dissave implies that the large amount of lifecycle consumption smoothing that we document cannot be solely achieved through traditional savings as the standard lifecycle model predicts.<sup>5</sup> Second, despite the important role of informal arrangements in managing consumption insurance against unanticipated changes in income in poor countries ([Townsend, 1994](#), [Kinnan, 2014](#)), food gifts remain relatively constant across stages of life and hence do not contribute to consumption over the lifecycle.<sup>6</sup>

An important aspect of lifecycle smoothing is potential differences between food expenditure and consumption (measured in caloric intake) ([Aguiar and Hurst, 2005](#)). This is particularly relevant in the poor countries where food is the largest item of the consumption basket. In addition, price levels might differ across space even within rural and urban areas ([Deaton and Dupriez, 2011](#), [Gaddis, 2015](#)).<sup>7</sup> To abstract from prices and investigate differences between expenditure and consumption we study the lifecycle behavior of total caloric intake. We find that the lifecycle profile of caloric intake is considerably smoother than the lifecycle profile of food expenditure. Household caloric intake practically shows no hump over the lifecycle in SSA despite there being a hump in food expenditure. This result is closely related to the findings in [Aguiar and Hurst \(2005\)](#) for the U.S. and [Hicks \(2015\)](#) for Mexico. These authors show that

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<sup>3</sup>More than 80% of the population in Malawi and Uganda lives in rural areas. In Nigeria, this figure is 68%.

<sup>4</sup>Maize consumption in Malawi is the most important contributor to total household caloric intake, 65% in rural areas and 45% in urban areas.

<sup>5</sup>The standard lifecycle model implies that consumption smoothing is achieved through the accumulation of assets when households are young and dissaving when households are old. In contrast, in the context of our poor SSA economies we show that wealth accumulation is low and that there is no evidence of dissaving accumulated assets in old age.

<sup>6</sup>There is evidence of larger transfers in South Africa, a country several times richer than the ones we study where state pensions are available ([Case and Deaton, 1998](#)). The study of smoothing against anticipated changes in income has been studied in the context of more developed countries ([Browning and Collado, 2001](#), [Berg, 2013](#)).

<sup>7</sup>Note that to transform nominal prices to real we use CPI measures that differ across rural and urban areas, but these CPI measures do not differ within areas.

food consumption remains stable with age as retired households substitute away from eating out and spend more time shopping and preparing food at home. In contrast to these authors, the smoothing strategy in SSA consists in substituting away from purchased food and into self-farmed food.

Our third finding is that this smoothing strategy has two costly consequences. The first cost is that school-age children in households headed by the elderly work more hours and are less likely to attend school. Children in a household with an elderly head are 41% less likely to attend school when compared to children in households with young heads. While the household head and spouse decrease the number of hours worked in old age, the hours spent in self-farming by their cohabiting adult children increases by 12% and that of school-age children by 33% over the lifecycle. This link between the age of the household and labor supply speaks to the result of [LaFave and Thomas \(2016\)](#). They provide empirical results rejecting the validity of the farm household model that assumes complete markets. Were markets complete, the household decision on how much labor to use should be independent of the household composition (age of the head and household size). They show that this is not the case with Indonesian data. We find that this is not the case in Malawi either. Our results suggest that in an economy where traditional savings mechanisms are not available, households use their own children (during their school years and as adults) to increase labor supply into self-farming as the household head ages—even though these members may be better employed elsewhere (e.g., school-age children should be attending school).

The second cost is a decrease in the nutritional quality of the household food intake as the head reaches old age. Maize consumption in Malawi, for example, rises over the lifecycle and provides calories and iron, but not much more. There is a household-level decrease in the intake of micro nutrients such as vitamin A, B12, C and D and macro nutrients such as sugar and fat.<sup>8</sup> On top of working more hours with less schooling, a less nutritious diet can diminish the ability of school-age children to acquire human capital ([Schultz, 1999](#), [Behrman, 2009](#), [Maluccio et al., 2009](#)) and cognitive skills ([Feyrer et al., 2013](#)).<sup>9</sup> Thus, the young children bear a double burden from the main consumption smoothing strategy in SSA. Further, the struggle to smooth caloric intake in old age by turning into self-farming directly speaks to the literature on the “Food Problem” ([Schultz, 1953](#), [Timmer, 2002](#)) which can have long-term implications for aggregate development ([Gollin et al., 2007](#)). In particular, in order to meet subsistence needs, adult children

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<sup>8</sup>This result holds for Malawi and Uganda. In Nigeria, a richer country, nutrient intake is as stable in old age as caloric intake, suggesting the nutritional loss in old age might depend on the stage of economic development.

<sup>9</sup>The loss of nutritional intake in old age is also potentially linked to the deterioration in cognitive health and skills of the elderly in Africa recently reported in [Payne et al. \(2013, 2016\)](#), a relation that we think deserves further exploration. This is relevant for policy as SSA is aging ([Payne et al., 2013](#)) and an older and less healthy population can represent an important burden for economic growth ([Weil, 2014](#)).

cohabiting with elderly heads focus on self-farming instead of looking for alternative occupations in more productive sectors (Gollin et al., 2014).

Our paper relates closely to Oliveira (2015), who uses the incidence of identical twins to infer the causal effect of family size on old age support in China. Elderly household with larger families are more likely to have a co-habiting child and receive more transfers. In Malawi, we find that 56% of elderly households (head aged 55 or more) have at least one cohabiting adult child and 66% has at least one school-age child. This is consistent with results for China where 32% of elderly households cohabit with an adult child. We go beyond Oliveira (2015)'s results in showing the cost of old-age support strategy: less schooling for school age children and lower nutritional quality of household food intake. Our findings also give empirical support to the trade-off between fertility and savings as a way to cope with old age (Boldrin and Jones (2002) and Banerjee et al. (2014)).<sup>10</sup> Our contribution is to discuss a precise mechanism through which children help the elderly cope with consumption in old age in SSA economies such as Malawi: cohabitation and an increase in hours devoted to self-farming as opposed to alternative mechanisms such as lifecycle savings and food gifts.<sup>11</sup>

The rest of the paper proceeds as follows. Section 2 describes our data and discusses the construction of household consumption and expenditure. In Section 3, we specify our empirical strategy based on a simple lifecycle model with two consumption goods. Our main empirical results are discussed in Section 4. We conclude in Section 5.

## 2 Data and Measurement Issues

We work with the Integrated Surveys on Agriculture (ISA) recently collected under the umbrella of the Living Standards Measurement Study (LSMS) of the World Bank. The ISAs are seen as a clear improvement on previous LSMS rounds (Carletto et al., 2010) and they are unique in the level of detail on nondurable and durable consumption (Beegle et al., 2012).<sup>12</sup> We focus the discussion on Malawi because it has the most detailed ISA questionnaire and the largest sample size with two cross-sectional waves; 11,280 in 2004-05 and 12,271 in 2010-11, and an additional

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<sup>10</sup>Boldrin and Jones (2002) model the help from children as a transfer and abstract from the specific mechanisms through which that transfer occurs. Banerjee et al. (2014) show survey evidence that the elderly 'perceive' their children as helping them in old age, but the precise mechanism is not identified. Our results show that cohabitation and the associated self-farming labor supply of children are key in the context of Malawi.

<sup>11</sup>Other studies have focused on the transfers from parents to children and on risk-sharing among family members, see Hayashi et al. (1996) and Akin and Leukhina (2015).

<sup>12</sup>A large part of the ISA improvements draw on Grosh and Glewwe (2000) that include specific issues on consumption measurement (Grosh and Deaton, 2000).

panel wave between 2010 and 2013 of 3,247 households.<sup>13</sup> Parallel results for Uganda and Nigeria are available in the online Appendix. The surveys in Uganda and Nigeria have a smaller sample, respectively 3,200 and 5,000 households per wave. There are three waves for Uganda (2005-06, 2009-10, 2010-11, 2011-2012) and two for Nigeria (2010-11 and 2012-2013). Using 2010 as a comparison year, 84% of the Malawi sample is rural; respectively 71% and 85% in Nigeria and Uganda.

The ISAs are particularly detailed in capturing food consumption. Food consumed is recorded by origin including purchases, self-farmed production and received gifts. To construct food expenditure we attach consumption prices to the quantities of self-farmed food and food gifts.<sup>14</sup> This way, our measure of food expenditure includes not only food purchases but also self-farmed food and food gifts. This is essential for the SSA countries that we study because the value of self-farmed food represents close to 50% of the total value of household food expenditure, and the total value of food expenditure is roughly 60% of total expenditure (De Magalhães and Santaaulàlia-Llopis, 2018).

Seasonality is an important aspect of consumption in SSA that deserve further discussion. This is particularly relevant for food consumption, which is reported with a 7-day recall (other consumption items are usually reported with longer recalls). Given the short recall period, food consumption may exhibit monthly patterns (Paxson, 1993). Since the Malawi surveys in 2004/05 and 2010/11 are rolled out across the year from March to March, we can control for seasonality with monthly dummies.<sup>15</sup> Once the value of food consumption has been deseasonalized, we create a measure of total food expenditure: the sum of food purchases and the monetary value of self-farmed food and received food gifts.<sup>16</sup>

Direct measures of food consumption, i.e., the intake of calories and other micro and/or macro

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<sup>13</sup>The Malawi ISA is also labeled as the Integrated Household Survey (IHS). The current ISA versions that we study are a considerable improvement on the first IHS1 wave available for 1997-1998. So much so that we believe it is best to restrain our attention to the last three waves, as the IHS1 data may not be directly comparable.

<sup>14</sup>ISAs report the value of the purchase of each item and the quantity purchased. With these data we construct a series of household specific prices. We then calculate the median price for each item in each of 6 regions (rural and urban in the north, south, and center) and for two seasons (post-harvest and pre-harvest). These prices are used to assign a monetary value to self-produced food and gifts in kind (De Magalhães and Santaaulàlia-Llopis, 2018).

<sup>15</sup>The 2013 Malawi ISA survey is rolled over six months. The Nigeria surveys take place in two different points in time: pre and post harvest. At each visit a 7-day recall food consumption questionnaire is applied. This double visit allows us to account for seasonality in Nigeria. The annualized food expenditure/consumption is the average of the pre and post harvest answers. In Uganda the surveys are not rolled out throughout the year, but across all waves there are data for all months and we are able to deseasonalize the data in a similar manner to Malawi.

<sup>16</sup>To transform nominal variables into real we use official CPI measures from the National Statistics Office (NSO) in Malawi that differ across rural and urban areas. Spatial differences in prices might introduce additional biases in the comparison of expenditure across households within rural and urban areas, although this is more of a concern for larger countries (Deaton and Dupriez, 2011, Gaddis, 2015).

nutrients, help circumvent problems of measurement relating to prices. In this direction, the ISAs allow us to isolate the effects of prices and distinguish between consumption and expenditure because the quantity of food consumed is also carefully recorded. These quantities are reported in units that must be converted to kilograms.<sup>17</sup> The survey for Malawi allows for 135 separate food items to be reported and includes any items consumed outside the home. With such level of detail the food basket of Malawian household can be accurately recovered.<sup>18</sup> We use the Food Composition Tables from the United States Department of Agriculture (USDA) National Nutrient Database to compute the nutritional intake of each and all of the food items consumed. In our analysis we include calories and other macro-nutrients (fat and sugar), minerals (iron and zinc), and vitamins (A, B12, C and D); see our discussion in Section 4.2.<sup>19</sup>

Nondurable expenditure other than food (62% of average household consumption in Malawi) are classified under alcohol and tobacco (negligible), clothing (3%), health (i.e., prevention, treatment, hospitalization, and traditional healers — 2%), education (2%), utilities (15%), housing (i.e, mostly self-reported rental value of dwelling or rent — 2%), transportation (1%) and other nondurables (13%)<sup>20</sup>. This level of detail is similar in the Nigeria and Uganda surveys.

### 3 Theory and Empirical Strategy

We present a lifecycle model à la [Attanasio et al. \(1999\)](#) to guide our empirical analysis in Section 3.1. Importantly, we distinguish between food and nonfood consumption. We discuss household structure in Section 3.2 and our empirical strategy in Section 3.3.

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<sup>17</sup>[De Magalhães and Santaaulàlia-Llopis \(2018\)](#) discuss in detail the price method we use to generate conversion rates. This conversion is also performed for Nigeria. The Uganda data is already available in kilograms.

<sup>18</sup>The Uganda survey lists 60 different food items and Nigeria 89. Unlike Malawi and Uganda, the Nigeria survey does not provide a list of food items consumed outside the home, only their overall monetary value. This difference in the level of detail in food consumption is another reason for our focus on Malawi. Note that the objective of the paper is not to estimate the precise level of caloric intake, but to estimate the lifecycle behavior in consumption. For this purpose the number of items present in the Uganda and Nigeria are more than sufficient as they include all staple foods and more.

<sup>19</sup>The use of nutrient intake for consumption comparisons across households is not straight-forward as the need for different types of nutrients might differ across persons, regions, and time ([Behrman and Deolalikar, 1990](#), [Alderman et al., 2008](#), [Pitt et al., 2012](#)). See [Eli and Li \(2015\)](#) for a pioneering treatment of some these concerns in terms of caloric requirements. Our analysis does not focus on requirements but on actual intakes of not only calories but also other micro and macro-nutrients.

<sup>20</sup>For example: fuel, newspaper and paper products, milling fees, hygiene and cleaning products, cooking and cleaning utensils, repair costs, cell phones, carpets and rugs, mats and linen, mosquito nets, rubber, plastics, construction and repair materials, mortgage payments, marriage and funeral costs and bridewealth costs.



### 3.1 A Lifecycle Model with Two Consumption Goods: Food and Nonfood

A household lives for a finite number of periods until age  $J$ . Each household maximizes lifetime utility by choosing age profiles of household food consumption,  $c_{a,j}$ , and household nonfood consumption,  $c_{m,j}$ , as follows:

$$\max_{\{c_{a,j}, c_{m,j}, a_j\}_{j=0}^J} \sum_{j=0}^J \beta^j [u(c_{a,j}) \exp(\theta'_a z_j) + \kappa v(c_{m,j}) \exp(\theta'_m z_j)],$$

subject to a budget constraint  $p_a c_{a,j} + c_{m,j} + a_{j+1} = y_j + (1+r)a_j$  given  $a_0$  and an income stream  $\{y_j\}_0^J$ . We denote with  $p_a$  the relative price of food in terms of nonfood consumption good and  $a_j$  is a risk-free asset with a constant return  $r$ . We assume additive separability of the utility function across consumption goods as is standard in the structural transformation literature (Gollin et al., 2002, 2007). In our preferences we have a time discount factor  $\beta$  and a set of household characteristics that may affect each consumption good differently;  $\kappa$  denotes the weight of non-food consumption relative to food consumption. We denote the household characteristics as vector  $z_j$ , namely household structure. Since household structure may have different effects across consumption goods, through the vectors  $\theta_a$  and  $\theta_m$ , each household member may potentially have a different share per consumption good (Aguilar and Hurst, 2014). For example, children might require a higher share of food consumption than of other consumption goods.

Our model implies that households smooth both food and nonfood consumption in the sense of holding marginal utility constant over the lifecycle. This simply means that consumption follows the Euler equations (one per consumption good).<sup>21</sup> Moreover, assuming a constant relative risk aversion (CRRA) utility function separately for food and for nonfood consumption with coefficients  $\eta_a \geq 0$  and  $\eta_m \geq 0$ , respectively, we can rewrite the Euler equations after taking

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<sup>21</sup>To see this, isolate  $c_{m,j}$  from the budget constraint and plug it into the objective function to rewrite the household problem in terms of  $a_{j+1}$  and  $c_{a,j}$ . First, the intertemporal Euler equation of  $c_m$ , or first order condition of  $a_{j+1}$ , is

$$v_{c_{m,j}} \exp(\theta_m z_j) = \beta(1+r)v_{c_{m,j+1}} \exp(\theta_m z_{j+1}). \quad (1)$$

where  $v_{c_{m,j}} \exp(\theta_m z_j)$  is the marginal utility of nonfood consumption at age  $j$ , and  $v_{c_{m,j+1}} \exp(\theta_m z_{j+1})$  is the marginal utility of nonfood consumption at age  $j+1$ . Second, we plug the first order condition for  $c_{a,j}$ , i.e.,  $u_{c_{a,j}} \exp(\theta_a z_j) = p_a \kappa v_{c_{m,j}} \exp(\theta_m z_j)$ , into (1) to find the intertemporal Euler equation for  $c_a$ ,

$$u_{c_{a,j}} \exp(\theta_a z_j) = \beta(1+r)u_{c_{a,j+1}} \exp(\theta_a z_{j+1}). \quad (2)$$

where  $u_{c_{a,j}} \exp(\theta_a z_j)$  is the marginal utility of food consumption at age  $j$ , and  $u_{c_{a,j+1}} \exp(\theta_a z_{j+1})$  is the marginal utility of food consumption at age  $j+1$ . Assuming a CRRA utility function in (1) and (2) we obtain (3).

logs as

$$\ln c_{i,j+1} - \ln c_{i,j} = \text{cons.} + \frac{1}{\eta_i} \theta'_i (z_{j+1} - z_j) \quad (3)$$

for  $i = \{a, m\}$  and the constant is  $\frac{1}{\eta_i} \ln \beta(1 + r)$ . If  $\beta(1 + r)$  is larger (smaller) than one consumption linearly increases (decreases) over the life cycle. Then, note that only changes in household structure  $z_j$  can generate nonlinear paths (i.e, humps) in consumption over the lifecycle. We empirically test equation (3) separately for rural and urban areas. Before that, we explore the behavior of household structure over the lifecycle.

### 3.2 Household Structure Over the Lifecycle

We document the behavior of household structure by household heads' age groups separately for rural and urban areas for Malawi.<sup>22</sup> The age of the head is a good indicator for the age of the household. Only 3.7% of households have an adult that is at least five years older than the head.<sup>23</sup> The average age of household heads is larger in rural areas, 43, than in urban areas 39. Overall, household size shows a clear lifecycle hump in both rural and urban areas (Table 1).

Household heads in both rural and urban areas are predominantly married with 70% of heads having a cohabiting spouse in rural areas and 71% in urban areas.<sup>24</sup> In rural areas, 70% of heads aged 15-24 have a cohabiting spouse, a figure that increases to roughly 80% for heads aged 25-44 and slowly decreases thereafter to reach 50% for heads aged more than 65 (panel A2, Table 1). Urban areas follow a similar pattern (panel B2, Table 1).<sup>25</sup>

The number of school-age children in rural households peaks among heads aged 35-44. These households have an average of 3.7 school-age children (rows 2 and 3, Panel A2, Table 1). This number decreases gradually to 1.5 for heads aged above 65. A less prominent hump is present in urban areas. A child is defined as a son, daughter, nephew, niece, grandchild, or an

<sup>22</sup>The unit of analysis is the household. Individual level consumption data is not available. This is the norm for developing countries (e.g., LSMS in various countries) or developed countries (e.g. Consumption Expenditure Survey in the US). Given this lack of individual level data, a growing literature attempts to estimate the consumption share of different household members given this data restriction, e.g., [Dunbar et al. \(2013\)](#). An interesting exception using individual consumption data from the China Health and Nutrition Survey is [Santaeuàlia-Llopis and Zheng \(2017\)](#).

<sup>23</sup>All our results are robust to restricting the sample to the remaining 96.3% of households.

<sup>24</sup>LSMS-ISAs' household roster provides demographic information about each and all members of the household. In particular, the relationship between each member and the household head is identified. Relatives who are members of the household include children (i.e., son/daughter-in-law, niece/nephew, grandchildren), wife/husband, father/mother, father/mother-in-law, brother/sister, brother/sister-in-law, and grandfather/grandmother. Non-relatives who are members of the household include servants and lodgers living in the household.

<sup>25</sup>This is a reminiscent of lower age at first marriage in rural areas ([Palamuleni, 2011](#)).

adopted/fostered child of the household head.<sup>26</sup>

The number of adult children cohabiting with the head mostly increases over the lifecycle.<sup>27</sup> In rural areas, the number of cohabiting adults peaks at 0.8 for heads aged 55-64, and then drops to 0.5 for heads above 65. In urban areas, the peak occurs at 1.5 for heads aged 55-64 and remains high at 1.2 for heads above 65. As we will see below, a substitution away from purchased food towards home produced foods is a key mechanism to smooth consumption in old age. The number of adult and school-age children living with elderly parents (and helping with home production) may be an important channel through which households maintain their level of household consumption when the head reaches old age.

### 3.3 Empirical Strategy

We now empirically assess the ability of rural and urban households to smooth lifecycle consumption defined as keeping marginal utilities relatively constant across stages of life as per equation (3). It is common practice to directly assess smoothing behavior over the lifecycle by studying the age profiles of expenditure in panels of cross-sectional data ([Aguiar and Hurst, 2014](#)).

**Household-level specification.** We estimate the mean lifecycle profiles of household-level expenditure with the following regression:

$$\ln C_{it}^k = \beta_0^k + f(a_{it}; \Theta) + \mathbf{1}_t \beta_t^k + \mathbf{1}_b \beta_b^k + \epsilon_{it}^k, \quad (4)$$

where  $C_{it}^k$  is the household expenditure of household  $i$  during period  $t$  on expenditure category  $k$  (e.g., food and nonfood);  $a_{it}$  is the age of the household head (for ages 26-65) and  $f(a; \Theta)$  is a function relating age and expenditure;  $t$  are time dummies for each household survey (e.g., Malawi ISA 2004/05, 2010/11, and 2013);  $b$  are cohort dummies;<sup>28</sup> and  $\beta_0^k$  is the expenditure level of category  $k$  at age 25.

Our first and benchmark specification does not impose any restriction on the functional form between age and consumption, and we represent  $f(a_{it}, \Theta)$  with a full set of age dummies, i.e.,  $\mathbf{1}_a \beta_a^k$ . Note that under this specification age, time and cohort effects are not linearly independent from each other (i.e.,  $b = t - a$ ) and only two of the three dummy controls can

<sup>26</sup>In Malawi, 17% of households have at least one child whose parents do not live in the household ([Penglase, 2018](#)). In the online Appendix we show that our results on children hours worked and schooling in section 4.3 are robust to restricting the sample to children where both parents are present (that is, excluding households with adopted/fostered and single-parent children.)

<sup>27</sup>Some of these adult children have been fostered or adopted. Hence the non-negligible number of adult children in household with heads in the age bracket 15-24.

<sup>28</sup>Cohort effects are estimated with birth year dummies.

be operative (Deaton, 1997, Heathcote et al., 2005). That is, the identification of  $\beta_a$  requires additional assumptions. Our benchmark specification is defined by age and time controls only, that is, we drop the cohort effects from equation 4. This choice is guided by the historical events in these economies that suggest that time effects unambiguously play a key role. For example, Malawi faced a famine the year before the 2004-5 survey and by 2010-11 the economy had not only recovered fully but a program of widespread fertilizer subsidy had been implemented. To assess whether cohorts effects shape our estimated age profiles we also consider a second specification in which we assume a cubic polynomial form for  $f(a_{it}, \Theta)$ . This avoids the multicollinearity issue discussed above and allows us to keep both time dummies and cohort dummies.<sup>29</sup> Our results are robust to this alternative specification. In the main text, we present results from the our benchmark (and arguably more parsimonious) specification. We refer the reader to the online Appendix for the estimates of our alternative specification.

**Adult-equivalent specification.** Given equation (3) (i.e., the Euler equation) we now additionally control for household structure and estimate lifecycle profiles of adult-equivalent expenditure as follows:

$$\ln C_{it}^k = \beta_0^k + f(a_{it}; \Theta) + \mathbf{1}_t \beta_t^k + \mathbf{1}_b \beta_b^k + \theta_{it}^k X_{it} + \epsilon_{it}^k, \quad (5)$$

where  $X_{it}$  is an additional vector of household structure characteristics that includes dummy variables for marital status, household size, and the number of male and female children in age categories 1-2, 3-5, 6-13, and 14-18. This implies that we take the equivalence scales (and household structure) as exogenous, as in Aguiar and Hurst (2014). The only difference is that we allow for the gender of the child and a thinner set of age categories of children defined as individuals under 18.<sup>30</sup> Again, as it was the case with the household-level specification, with the adult-equivalent specification we also focus in the main text on the results from our benchmark specification with age and time controls only, i.e., without cohort dummies. In the online Appendix, we show the results for the alternative specification that imposes a cubic polynomial on  $f(a_{it}; \Theta)$  and controls for both time and cohort dummies.<sup>31</sup>

<sup>29</sup> Adding more degrees to the polynomial does not improve the fit and we settle with the cubic specification.

<sup>30</sup> In Aguiar and Hurst (2014) children are household members up to the age of 21.

<sup>31</sup> In the online Appendix we show that our profile estimates are robust to restricting the sample fixed household structures: household with school-age children and no adults other than parents, all children and no adults other than adult children and parents, school-age children and all adults.

## 4 Empirical Results

First, we focus on lifecycle expenditure. We emphasize the differential behavior of rural and urban areas, food and nonfood expenditure, and the role of self-farming (Section 4.1). Second, we investigate the lifecycle behavior of consumption in terms of caloric intake and maize consumption (in kilograms) (Section 4.2). Third, we examine the consequences of lifecycle smoothing for child investments and nutrient intake (Section 4.3). Unless otherwise noted, our results focus on Malawi with more details on other SSA countries in the online Appendix.

### 4.1 Lifecycle Expenditure

We show the age profile of household-level nondurable expenditure (in logs) in Figure 1 using our more parsimonious specification described in Section 3.3 that control for time only. To facilitate exposition, the age profiles estimated with equations (4) and (5) are plotted after they have been normalized so that the value of the age dummy at age 25 is 0 (in logs). We plot these normalized age effects as well as a cubic polynomial that approximates the age effects.<sup>32</sup> Before dissecting the lifecycle behavior of household expenditure in poor countries, we contextualize it with respect to the U.S. (panel (a), Figure 1). Nationwide, household expenditure in Malawi increase by 0.25 log points between the age of 25 and its peak in early 40s, while household expenditure in the US increases by roughly twice as much, 0.42 log points, between the ages of 25 and its peak, somewhat later than Malawi, in the late 40s. That is, there is a clear lifecycle hump in nondurable expenditure in both countries but it is twice as prominent in the U.S. as in Malawi.

**The Rural-Urban Divide.** A potential explanation behind the nationwide differentials across countries is the rural-urban composition of the population. In Malawi, roughly 85% of the population lives in rural areas, while this figure is less than 1% in the U.S. We explore the lifecycle behavior of household expenditure separately for rural and urban Malawi (panel (b), Figure 1). In rural areas, the peak in nondurable expenditure is reached at 0.23 log points in the early 40s. The nondurable expenditure in urban areas peaks at 0.46 log points in the late 40s. Beyond the peak, nondurable expenditure reaches back the initial level at age 60 in rural areas with log deviation of -0.11 at age 65, while it remains always above the initial level in urban areas with a log deviation of 0.20 at age 65. This implies that the total range of household expenditure from its peak to its minimum is 0.34 log points in rural areas and 0.46 log points in urban areas, suggesting more lifecycle consumption smoothing in rural areas than in urban areas. The rural-urban divide largely accounts for the nationwide behavior of nondurable expenditure over

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<sup>32</sup>In the online Appendix we show the estimates for the specification that controls for cohorts, as well as age and time. We also normalized the value of the estimated cubic function so that it is 0 (in logs) at age 25.

the lifecycle: nationwide expenditure follows the behavior of rural areas. Interestingly, lifecycle expenditure in urban Malawi closely follows its U.S. counterpart (panel (b), Figure 1).

To examine the lifecycle effect of household structure, we compare the estimated age profiles from our household-level specification (equation (4)) against the same estimates from our adult-equivalent specification that controls for household structure characteristics (equation (5)). We show the age profiles when we control for household structure separately for rural and urban areas in Figure 2. Adult-equivalent expenditure shows a hump that peaks lower and at an earlier age over the lifecycle than its household-level counterpart. In rural areas, adult-equivalent expenditure increases by 0.06 log points from age 25 to its peak age. That is, household structure accounts for more than 2/3 of the lifecycle hump in expenditure in rural areas. In urban areas, adult-equivalent expenditure increases by 0.30 log points from age 25 to its peak age. This implies that household structure accounts for roughly 1/3 of the lifecycle hump in expenditure in urban areas.<sup>33</sup> Note that adult-equivalent expenditure has a higher peak and a steeper decline during old age in urban areas than in rural areas. The total range of adult-equivalent nondurable expenditure from its peak to its minimum at age 65 is 0.23 log points in rural areas and 0.39 log points in urban areas. This implies that, after controlling for household structure, we find twice more consumption smoothing in rural areas than in urban areas.

**Food and Nonfood Expenditure** To examine the source of the hump in adult-equivalent nondurable expenditure, we decompose the lifecycle profiles into food and nonfood. Food expenditure (panel (a), Figure 3) is smoother than nonfood expenditure (panel (b), Figure 3). In rural areas, food expenditure and nonfood expenditure peak in the early 30s at a similar level to age 25, a deviation of 0.06 log points, but the decline after the peak is starker for nonfood expenditure. Nonfood expenditure declines to -0.31 log points at age 65, while food expenditure declines by -0.13 log points. In urban areas, nonfood expenditure peaks at a larger level than food expenditure, respectively, by a deviation of 0.33 and 0.23 log points in the late 30s. As it was the case in rural areas, the decline in old age for nonfood expenditure is roughly three times larger than for food expenditure in urban areas. The total range of food expenditure is 0.19 log points in rural areas and 0.29 log points in urban areas, while the range in nonfood expenditure is 0.36 log points in rural areas and 0.49 log points in urban areas. This clearly implies better consumption smoothing over the lifecycle in rural areas than in urban areas, and in food expenditure than in nonfood expenditure. Food expenditure largely drives the behavior of nondurable expenditure, which is consistent with food expenditure representing respectively roughly 70% and

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<sup>33</sup>These are similar results to [Attanasio et al. \(1999\)](#), the excess sensitivity of consumption to anticipated income changes throughout the lifecycle can be partially explained by household structure.

60% of nondurable expenditure in rural and urban Malawi.<sup>34</sup> These shares are stable through the lifecycle (panel (c), Figure 3).

**The Role of Self-Farmed Food.** Given the role of food in explaining the smoothing of total expenditure, we now investigate food expenditure in more detail. In particular, we break down expenditure in different categories. We deconstruct adult-equivalent lifecycle behavior of food into purchases, the monetary value of self-farmed food, and received food gifts.<sup>35</sup>

First, the only category that goes up over the lifecycle is self-farmed food (left axis, panel (a), Figure 4). In rural areas the monetary value of self-farmed food is 0.22 log points higher at age 65 compared to age 25. The increase in urban areas is more pronounced in old age and the monetary value of self-farmed food is 0.52 log points higher by age 65. The share of self-farmed food also increases during the lifecycle: from 38% to 48% in rural areas and from 4% to 17% in urban areas (right axis, panel (a), Figure 4).<sup>36</sup>

Second, food purchases show a hump that decreases substantially after peaking around ages 30-40 (left axis, panel (b), Figure 4). The hump in food purchases is larger than that of total nondurable expenditure. The decrease is particularly strong in rural areas where the level of purchased food is below that of age 25 by age 40, and by age 65 the level is lower by -0.51 log points. In urban areas the level of purchased food by age 65 is below that of age 25 by -0.31 log points. The share of purchased food also decreases during the lifecycle: from 52% to 40% in rural areas and from 92% to 78% in urban areas (right axis, panel (b), Figure 4).

Third, the level of food expenditure from gifted consumption in rural areas is relatively flat throughout the lifecycle (panel (c)). In urban areas, we observe a hump shape peaking at age 45 and attaining the same level at 65 as that of age 25. In neither urban and rural areas does the share of received food gifts increase in old age. The share remains relatively stable at 10% in rural areas and 4% in urban areas.

Our decomposition of food expenditure suggests that the main mechanism to smooth food expenditure in old age is the substitution away from purchased food and into self-farmed food.<sup>37</sup> Our results cast doubt on two alternative traditional explanations for consumption smoothing over the lifecycle. First, the decrease in purchased food in old age together with the low ability

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<sup>34</sup>In the US, food represents less than 35% of nondurable expenditure (Aguilar and Hurst, 2014).

<sup>35</sup>Recall that we value self-farmed food consumed and food received as gifts consumed using prices constructed from food purchases (Section 2).

<sup>36</sup>The average plot size in urban areas is 0.4 acres (compared to 1.8 acres in rural). Urban households also produce mostly maize (74% of total urban agricultural production). It is likely that urban households farm for the purpose of food supplementation.

<sup>37</sup>This occurs in both rural and urban areas of Malawi and Uganda. In Nigeria, the substitution away from purchased food and into self-farmed food is also present but less pronounced. See our online Appendix.

to accumulate wealth and dissave suggests that traditional savings play a lesser role in explaining consumption smoothing mechanism for old age. To see this, we plot asset accumulation over the life cycle in terms of households net worth as well as land and livestock for rural and urban areas in Figure 5. These graphs show that wealth accumulation is low and, perhaps, more importantly, the behavior of wealth over the lifecycle suggests no sign of dissaving previously accumulated assets in old age.<sup>38</sup> That is, against what the standard lifecycle model predicts, net worth remains relatively constant after age 50, including land and livestock. This pattern of lifecycle accumulation of land and livestock (both farming inputs) further suggests a strategic move towards self-farming in old age which goes hand in hand with the increase in self-farming food consumption that we document. Second, the stability of food gifts over the lifecycle suggests that informal risk-sharing arrangements—which are important against unanticipated income shocks ([Townsend, 1994](#), [Kinnan, 2014](#))—do not contribute to consumption smoothing in old age.

Although suggestive, our results imply that alternative mechanisms to savings and gifts must be in place to smooth consumption across stages of life. In particular, the decline in purchases together with the stability of gifts implies that the increase in self-farming over the lifecycle that we document must be behind the observed smoothing in old age. In Section 4.3, we dig deeper into the mechanisms that sustain self-farming in old age and explore whether this consumption smoothing strategy entails costs.

## 4.2 Lifecycle Consumption

An important aspect of lifecycle smoothing are potential differences between food expenditure and consumption measured in caloric intake ([Aguilar and Hurst, 2005](#)). This is particularly relevant in poor countries because food is the largest item of the consumption basket. Indeed, the “humps” estimated may simply reflect the natural changes in preferences and needs that occur during the life cycle. For example, individuals may prefer more expensive calories when they are middle-aged than when they are elderly.<sup>39</sup> To partly address these issues, we need to abstract from prices. In this section, we study the lifecycle behavior of total caloric intake and the quantity consumed (in kilograms) of the main staple food (e.g., maize in Malawi).

<sup>38</sup>Precisely, net worth grows by a roughly a factor of 1.6 ( $\approx \exp(0.5)$ ) from age 25 to age 45-50 in rural areas and by a factor of 6.0 ( $\approx \exp(1.8)$ ) in urban areas (panel (a), Figure 5). This accumulation is very small compared with the factor of 22 in the U.S. ([De Magalhães and Santaaulàlia-Llopis, 2018](#)). Indeed, the presence of savings constraints in SSA has been emphasized earlier in [Dupas and Robinson \(2013a,b\)](#), [Karlán et al. \(2014\)](#), [Brune et al. \(2015\)](#). In addition, the use of land as a form of savings to be sold or rented-out in old age is limited by the notorious lack of land markets ([Restuccia and Santaaulàlia-Llopis, 2017](#)). Precisely, land and livestock which represents the largest assets in this economy barely grow by a factor of 1.5 and 2.0 from age 25 to age 45-50, respectively (see panel (b) and (c) in Figure 5).

<sup>39</sup>We thank an anonymous referee from pointing this out to us.



Adult equivalent food consumption, measured in terms of caloric intake, is more stable over the lifecycle than expenditure. In rural areas, caloric intake peaks in the early 30s with a deviation of 0.03 log points with respect to age 25, i.e., half the peak of food expenditure (panel (a), Figure 6). The decline after the peak is also less pronounced for caloric intake reaching a deviation of -0.04 log points at age 65 that is half that of food expenditure. In urban areas, caloric intake peaks in the late 30s with a deviation of 0.09 log points with respect to age 25, i.e., less than half the peak of food expenditure (panel (b), Figure 6). The decline of caloric intake after the peak is about the same as that of food expenditure, reaching a deviation of -0.06 log points at age 65. This implies that the total range of caloric intake over the lifecycle is 0.07 log points in rural areas and 0.15 log points in urban areas. Recall that for food expenditure these figures are respectively 0.19 for rural areas and 0.29 for urban areas. That is, households smooth caloric intake twice more than food expenditure in both rural and urban areas. Note that the rural-urban divide persists with consumption. Consumption is twice as smooth in rural as in urban areas.

Maize is by far the most important staple food in Malawi and represents 61% of the total household caloric intake (65% in rural areas and 46% in urban areas). Such a specialization in both production and consumption in Malawi provides us with a natural and direct way to compare consumption and expenditure. We find that household maize consumption (measured in kilograms) steadily grows throughout the lifecycle, both in rural and urban areas (respectively, panel (a) and (b), Figure 6). Indeed, Malawian households increase lifecycle maize consumption substituting away from other forms of food (panel (c), Figure 6). This implies that the consumption of maize largely drives the smoothing of caloric intake over the lifecycle. In section 4.3.2 we discuss what happens to the quality of food consumption.<sup>40</sup>

To sum up, households are capable of smoothing adult-equivalent consumption through the lifecycle to a much larger extent than what measures of adult-equivalent food expenditure suggest. This result echoes the results for the U.S. in [Aguilar and Hurst \(2005\)](#) and for Mexico in [Hicks \(2015\)](#) that find a stable caloric intake in old age, despite a decline of food expenditure in old age. In the case of Malawi, the consumption of self-farmed maize largely drives the smoothing of caloric intake over the lifecycle but at the expense of everything else. This potentially implies negative consequences for the quality of the food consumed in households headed by the elderly.

### 4.3 The Costs of Smoothing

In the previous section, we have showed a substantial ability to smooth lifecycle consumption and expenditure in Malawi. This smoothing is characterized by an increase in self-farmed food

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<sup>40</sup>Nigeria and Uganda have considerably more diverse diets and agricultural diversification than Malawi. We show the lifecycle caloric and nutrient intake for these countries in our online Appendix.

consumption, mainly, maize. We now examine two costly consequences of this smoothing strategy.

### 4.3.1 More Farm Work and Less Schooling

To study how the rise of self-farmed food is sustained over the lifecycle, we explore the behavior of household hours employed in self-farming, i.e., farm work conducted on the plots cultivated by the household. We focus the discussion on rural areas, where 85% of the population lives and 77% of the rural heads engage in self-farming. Household heads work an average of 26 hours per week and spend 61% of their working hours self-farming.<sup>41</sup> Spouses and cohabiting adult children work, respectively, 22 and 17 hours per week self-farming which implies that they spend an even higher percentage of their own working time in the household farm, respectively 93% and 89%.<sup>42</sup> School-age children do (on average) farm work for 8 hours a week which represents 97% of their total hours worked.<sup>43</sup>

Consistent with self-farmed food consumption, we find that household's hours worked on self-farming in rural areas grow roughly by 0.22 log points from ages 25 to 65 (panel (a), Figure 7). Interestingly, a decomposition of household hours worked on self-farming shows that household heads (and their spouses) increase these hours by almost only 0.1 log points from age 25 to 50, and decrease them thereafter. That is, the work of heads (and spouses) falls short in explaining the increase in household farm work. The increase in farm work is sustained by the hours that cohabiting children—both adult and school-age children—employ in self-farming. Adult children increase their hours in self farming by 0.12 log points and school-age children by 0.20 log points (panel (c), Figure 7). In other words, households seem to increasingly divert labor resources into self-farming over the lifecycle, a feature that is sustained by increasing the hours worked by children. Note that this increase in self-farming activities as a mechanism to provide consumption smoothing over the lifecycle is in itself a decision to smooth income—by shifting the households' income sources—over the lifecycle.<sup>44</sup>

This smoothing strategy has direct and costly consequences for children. We find that school-age children work more hours in households headed by the elderly and are less likely to attend school (panel (e), Figure 7).<sup>45</sup> To be precise, in households headed by a 65 year-old, school-

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<sup>41</sup>Regarding total hours per worker, we find a country average of 29 hours per week for household heads which is consistent with what [Bick et al. \(2016\)](#) find for Sub-Saharan countries.

<sup>42</sup>These numbers are for rural and conditional on there being a working spouse or adult child

<sup>43</sup>These numbers are conditional on having a child that works. Unconditionally, the average amount of hours that school-age children work self-farming is 5.3, which implies 95% of the total hours worked for this sample.

<sup>44</sup>Figure 7 shows similar results for urban areas. Note, however, that only 34% of urban household have agricultural land.

<sup>45</sup>Children aged 6 to 18 are classified as school-age. In panel (e), Figure 7 we normalize the average log hours worked by school-age children to be 0 when the head is aged 35. This is so because the count of children

age children spend (on average) 30% more hours self-farming than school-age children living in households with a 35 year-old head.<sup>46</sup> Further, more farm work conducted by school-age children is associated with less schooling. We find that the percentage of school-age children in a rural household *not* attending school increases from 19% in households with a head aged 35 to 24% for households with a head aged 65, i.e., an increase of 41%.

In Figures C.1 and C.2 we break down the the results in the above paragraph between primary (6-13) and secondary (14-18) school-age children. The number of primary school-age children not in school increases slightly over the lifecycle in rural areas, but the increase is not statistically significant. Hours worked in self-farming by primary school-age children increases over the lifecycle and this increase is statistically significant. Regarding secondary school-age children in rural areas, both the increase in hours worked in self farming and the increase in non-attendance are statistically significant. Moreover, we show in Figure C.1 and C.2 that these results are robust to excluding households with single-parents and with adopted/foster parents and focusing on households in which all children have both parents. This robustness exercise shows that our results are not due to a composition effect where older households are more likely to foster children and treat them differently ([Ainsworth, 1996](#), [Zimmerman, 2003](#), [Case et al., 2004](#), [Evans and Miguel, 2007](#), [Akresh, 2009](#)).<sup>47</sup>

These results suggest a substantial loss of human capital for future generations associated with consumption smoothing achieved through self-farming. School-age children raised in households with elderly heads are less likely to attend school and have to spend more time working on the farm. There is no indication that selection among school-age children is driving this results as the result is robust to households in which all children have both parents present. These children follow their parents in their choice to cohabit with the elderly head (i.e., the grandparent). It is likely there is some selection among the adult children who cohabit with their elderly parents. Note however, that even with selection among siblings, cohabiting adults would have been more efficiently employed elsewhere in the economy than in the subsistence sector ([Gollin et al., 2014](#)).<sup>48</sup>

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for households with very young heads is imprecise as we allow school-age children to include siblings, nephews, grand-children, foster and adopted children.

<sup>46</sup>Note that these profiles control for household composition and number of children of different age groups as described in Section 3.3.

<sup>47</sup>Another composition effect that may affect education is birth order ([Black et al., 2005](#), [Booth and Kee, 2009](#)). We are unable to explore this further as birth order cannot be determined in our data. Total fertility is not reported. Moreover, it is unclear how to assess birth order effects in grandchildren of different parents.

<sup>48</sup>The results for China in [Oliveira \(2015\)](#) speak to the potential selection issue among adult children. [Oliveira \(2015\)](#) shows that the incidence of twins (versus one child) in China increases the likelihood of cohabitation. Even though the twins are similar in most observables, one cohabits. This result suggest that selection is not the main driving force for cohabitation. In other words, even if all the adult children had a better outside employment options, one of them is likely to cohabit with their elderly parent.

### 4.3.2 A Nutritional Loss

A consumption smoothing strategy by which elderly households divert resources into self-farmed foods, mainly, maize, is likely to have negative consequences on the quality of food intake. We find that this is the case in adult equivalent nutrient intake. Consistent with a diet where maize is the staple food, households are able to smooth iron and zinc in both rural and urban areas, respectively, in panel (a) and (b) of Figure 8. In contrast, a look to vitamins shows a very different story. In rural areas, the consumption of vitamin A, B12, C and D show a similar but even larger hump and range over the lifecycle than food expenditure. In particular, there is a substantial nutrient loss in terms of all vitamins consumption at age 65 with log deviations of -0.10 for vitamin C, -0.13 for vitamin A, -0.18 for vitamin D and -0.19 for vitamin B12 compared with age 25 consumption (panel (c), Figure 8).<sup>49</sup> This loss in vitamins consumption is between two and five times that of caloric intake that is barely -0.04 log points at age 65. For the 15% of the population that lives in urban areas, the nutritional loss in old age is particularly stark for vitamin B12 and vitamin D with log deviations of, respectively, -0.37 and -0.20 compared with age 25 consumption (panel (d), Figure 8). Interestingly, vitamin A and C grow and smooth better over the lifecycle in urban areas. Finally, macro nutrients such as fat and sugar intake also drop in both rural and urban areas below the levels at age 25 (panel (e) and (f), Figure 8). Overall, there is a clear reduction in the quality of household food intake in households with an elderly head. This is consistent with a substitution of most food items toward the consumption of the staple food, maize. Maize provides calories and iron, but not much more.<sup>50</sup>

Our findings contrast with previous results for richer countries such as the US where food quality remains stable in old age ([Aguilar and Hurst, 2005](#)), suggesting that these results can depend on the aggregate stage of economic development. Smoothing in old age that is achieved through (dis)savings or social security systems that provide pension income (which are features of more developed economies) are likely to affect diet variety much less than smoothing strategies that rely on increasing self-farming staple food in old age.

## 5 Conclusion

The incentives to smooth consumption over the lifecycle are powerful. Our investigation shows that households in some of the world poorest countries are able to smooth consumption fairly well throughout the lifecycle. We find that this successful smoothing strategy is characterized

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<sup>49</sup>The levels at age 25 are statistically different from zero. In order to keep Figure 8 easy to read, we do not provide confidence intervals.

<sup>50</sup>We find a similar drop in nutrition quality in Uganda, and less so for Nigeria, a richer economy; see our online Appendix.

by the substitution away from purchased food and into self-farmed staple food (e.g., maize in Malawi) in old age. This strategy operates through a new mechanism by which household heads cohabit with their children in order to smooth consumption by shifting labor supply (hours of family members, in particular, of their children) to self-farming. Our results provide an alternative mechanism to the standard lifecycle theory in which consumption smoothing is achieved through traditional saving methods, which can be inaccessible to the SSA populations that we study, or through food transfers across generations.

The lifecycle shift toward self-farmed food has two important costly consequences. First, school-age children are diverted away from school and toward cultivation of self-farmed food, thus lowering education attainment and human capital accumulation. Second, the nutritional quality of household's food consumption is substantially reduced. For example, in Malawi, a diet in which the importance of maize consumption increases over the lifecycle provides iron and zinc for individuals living with elderly heads, but not much more. Moreover, these two costs are intertwined as poor nutrition in children can lead to lower schooling ([Behrman, 2009](#)).

Ultimately, our results suggest that consumption smoothing based on self-farming can provide a breeding ground for aggregate stagnation with low schooling and poor nutrition. The choice of this consumption smoothing strategy despite its costs suggests that the incentives for smoothing potentially overpower the incentives to generate economic growth in the poor countries that we study.<sup>51</sup> An argument that we think deserves further exploration. In this direction, the provision of alternative mechanisms to smooth consumption in old age (e.g., a higher ability to save or direct transfers to the elderly) is likely to help kick-start economic growth. Some evidence that such a policy could work can be seen in [Bethencourt and Ríos-Rull \(2009\)](#). They show— for the US —that as the relative income of elderly widows grow relative to the income of their adult children, cohabitation is less likely. This suggests that interventions of providing pension income to the elderly in Malawi may reduce co-habitation and the costs associated with it, particularly, less schooling. We leave all these interesting questions for future research.

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<sup>51</sup>This discussion echoes the trade-off between consumption insurance and economic growth recently documented in [Santaeulàlia-Llopis and Zheng \(2018\)](#).

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Table 1: Household Structure (Malawi ISA 2010/11)

(A) Rural Residency

(A1) Population Shares (%) by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Population 2010	9	29	22	15	11	13

(A2) Household Structure by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Spouse	0.7	0.8	0.8	0.7	0.6	0.5
Children (< 6)	1.0	1.3	1.2	0.8	0.4	0.2
Children (6-18)	0.5	1.1	2.5	2.5	1.8	1.3
Adult children (>18)	0.1	0.1	0.2	0.6	0.7	0.4
Adults (other) (>18)	0.0	0.0	0.0	0.0	0.0	0.0
Household Size	3.0	4.3	5.7	5.6	4.6	3.5

(B) Urban Residency

(B1) Population Shares (%) by Age Group

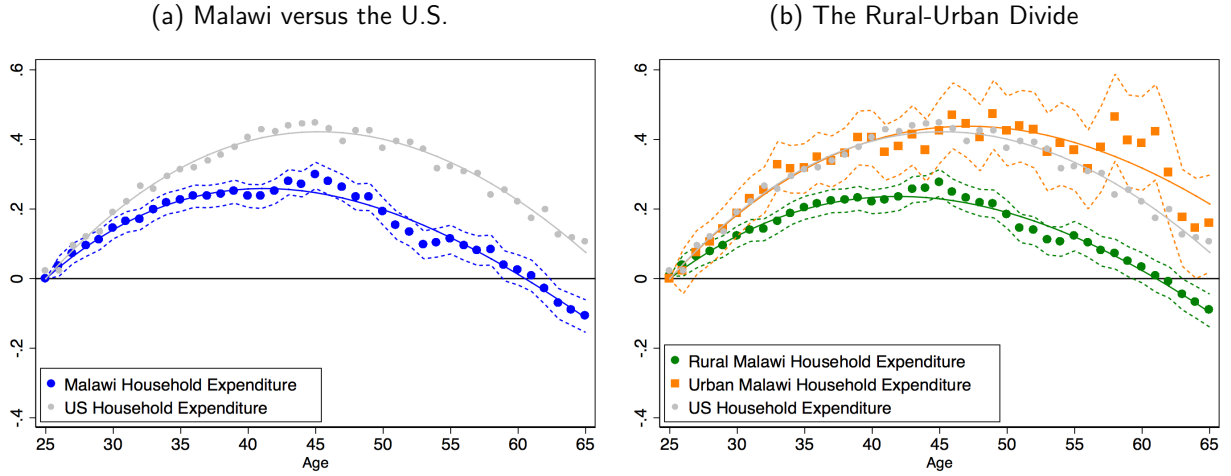
	15-24	25-34	35-44	45-54	55-64	65+
Population 2010	8	40	25	13	7	6

(B2) Household Structure by Age Group

	15-24	25-34	35-44	45-54	55-64	65+
Spouse	0.5	0.7	0.8	0.7	0.6	0.6
Children (< 6)	0.5	0.9	0.8	0.5	0.5	0.4
Children (6-18)	0.6	0.9	2.0	2.2	1.8	1.7
Adult children (>18)	0.1	0.1	0.4	1.0	1.3	1.0
Adults (other) (> 18)	0.1	0.1	0.1	0.1	0.1	0.0
Household Size	2.7	3.8	5.1	5.6	5.3	4.8

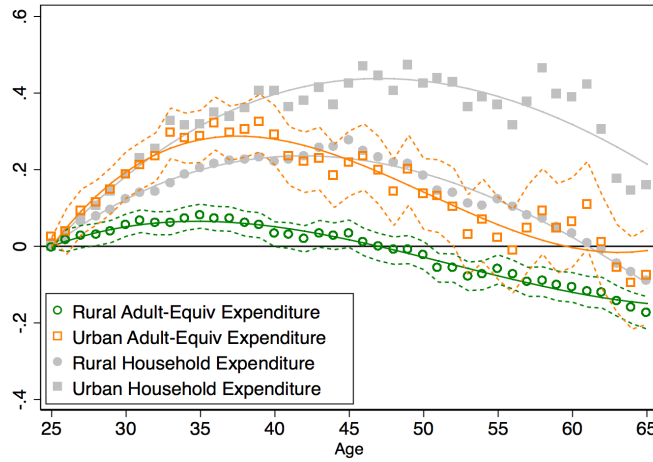
*Notes:* The data refer to the Malawi ISA 2010/11. We obtain similar insights for the alternative Malawi ISA surveys in 2004/05 and 2013. Children are defined as sons, daughters, nephews, nieces, grandchildren, or adopted/fostered children of the household head. Adult children refer to the household's head sons and daughters aged 19 or above. The relationship between each member of the household and the household head is collected in the household roster that includes relatives and non-relatives (e.g. servants and lodgers) living in the household at least 9 months in the last year.

Figure 1: Lifecycle Household Expenditure: Malawi, the U.S. and the Rural-Urban Divide



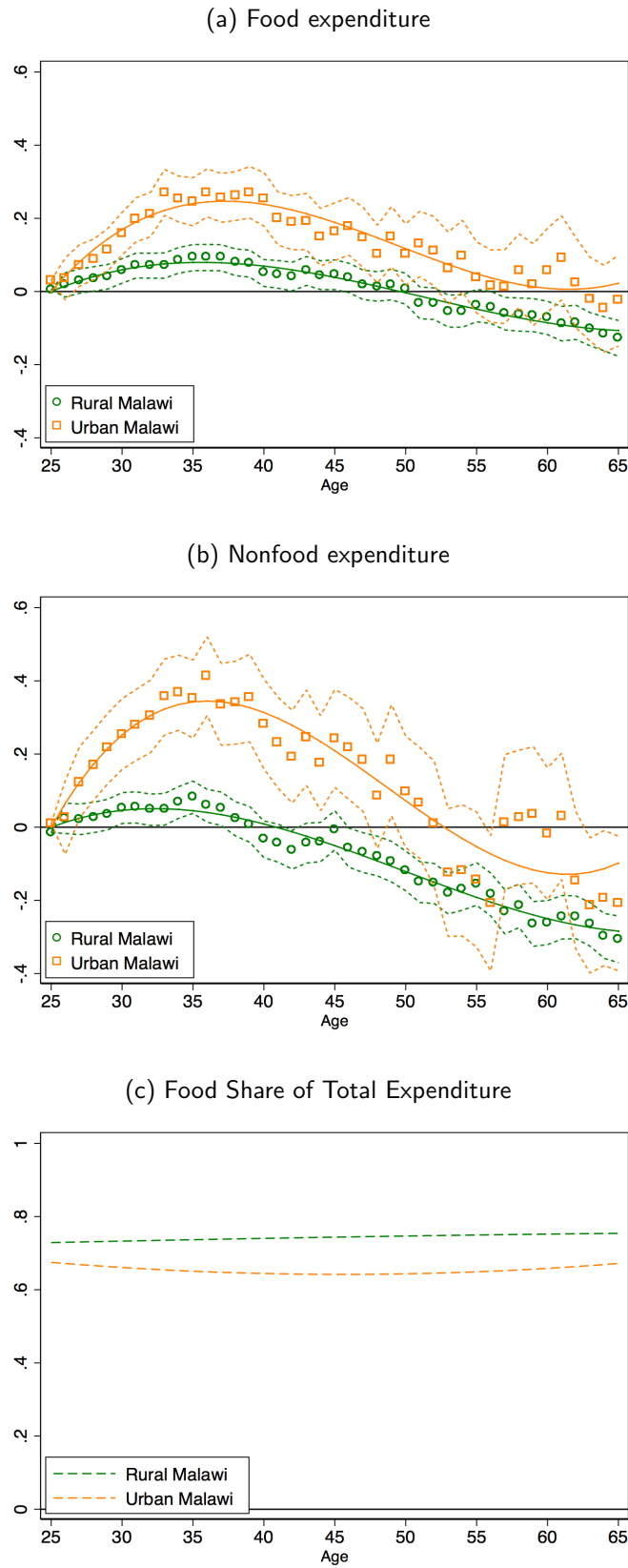
*Notes:* Panel (a) shows household-level nondurable expenditure over the lifecycle in Malawi and in the US. Nondurable expenditure is defined in Section 2 and our empirical strategy in Section 3.3. The US profile is taken directly from [Aguir and Hurst \(2014\)](#). Panel (b) additionally decomposes household nondurable expenditure over the lifecycle in the rural and urban areas of Malawi. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors.

Figure 2: The Role of Household Structure



*Notes:* The adult-equivalent expenditure is defined in Section 3.3. To show the role of household structure in Malawi we overlay adult-equivalent expenditure with the urban and rural household expenditure profiles from panel (b) of Figure 1 (gray lines). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors.

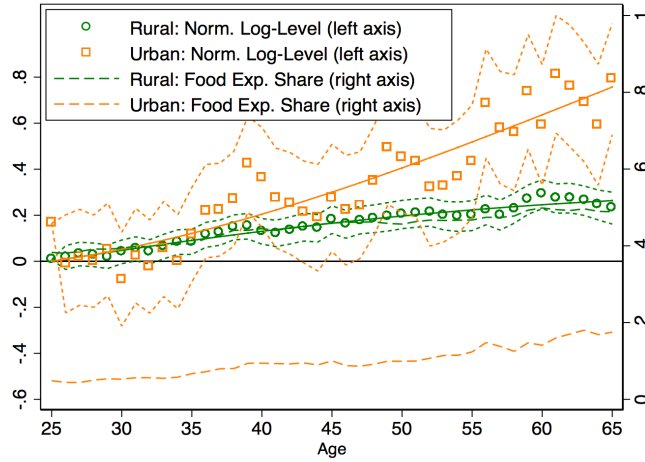
Figure 3: Lifecycle Food and Nonfood Expenditure



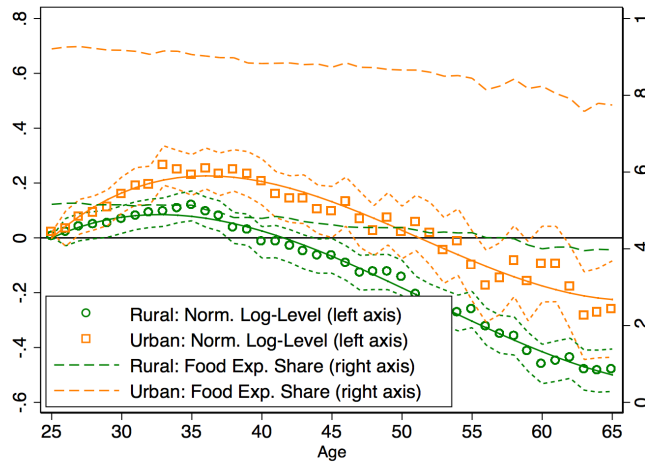
*Notes:* The expenditure profiles in rural and urban Malawi are decomposed into food and nonfood expenditure in respectively panel (a) and (b). We plot the food share of total nondurable expenditure in panel (c). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors. All profiles are plotted in adult-equivalent terms.

Figure 4: Deconstructing Lifecycle Food Expenditure

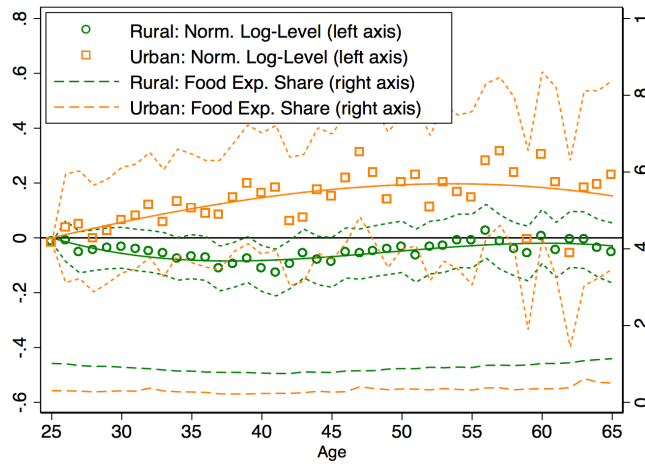
(a) Self-Farmed Food



(b) Food Purchases



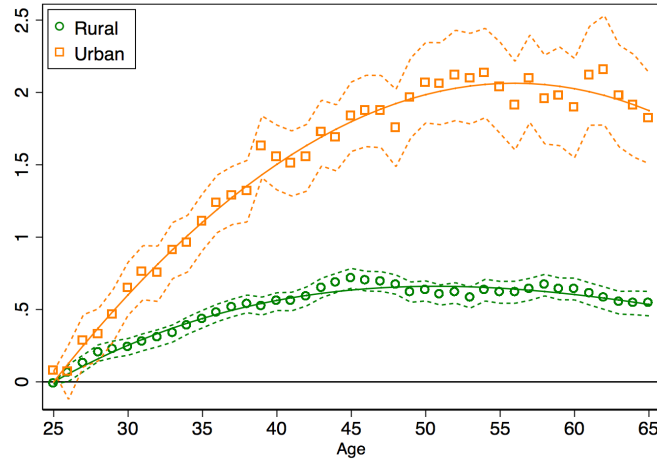
(c) Food Received as Gift



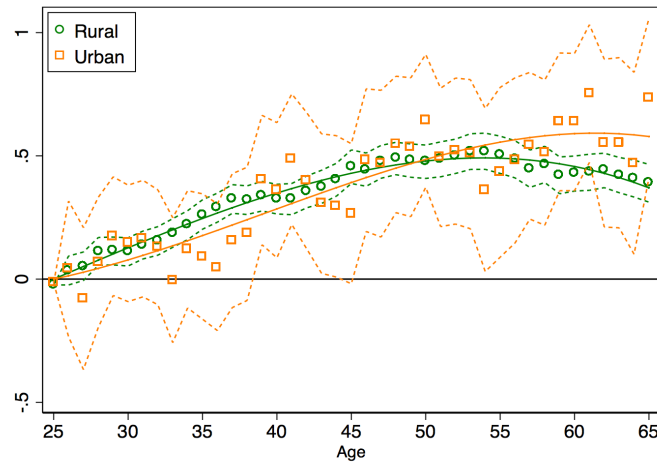
*Notes:* We break down food expenditure in Malawi by its origin (left axis): self-farmed food in panel (a), food purchases in panel (b), and food received as gift in panel (c). In each panel we overlay the lifecycle profiles with the expenditure share out of total food expenditure (right axis). See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors. All profiles are plotted in adult-equivalent terms.

Figure 5: Lifecycle Wealth

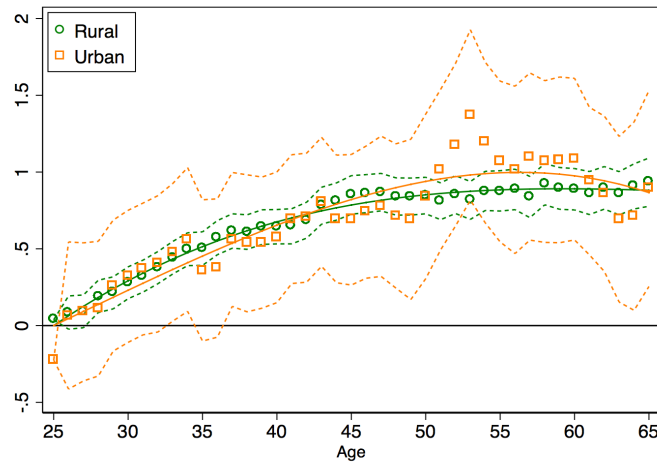
(a) Net Worth



(b) Land Size



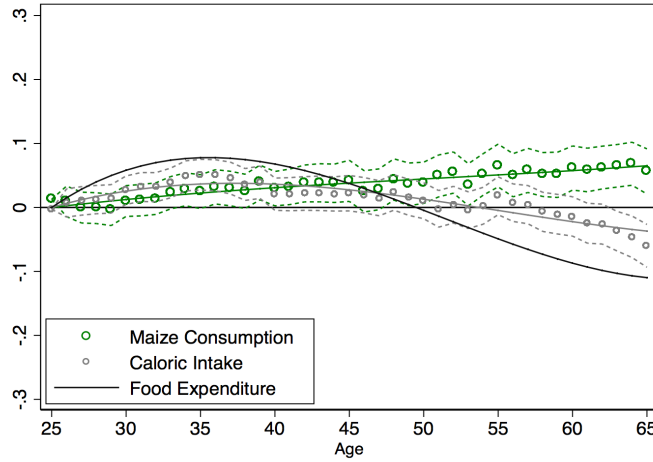
(c) Livestock



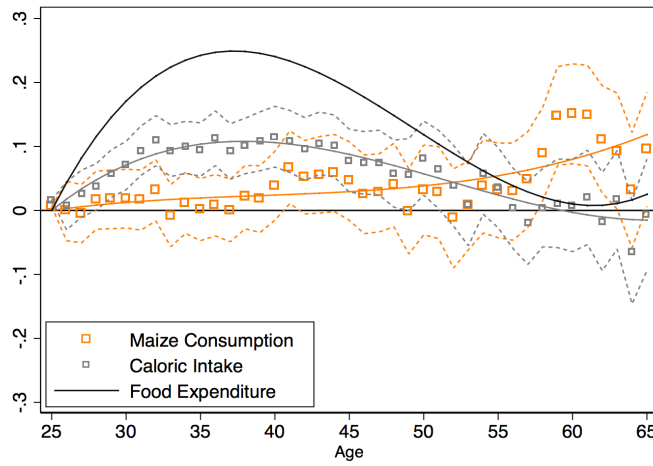
*Notes:* We plot the accumulation of net worth, land size, and livestock over the lifecycle in the rural and urban areas of Malawi. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors. All profiles are plotted at the household level.

Figure 6: Lifecycle Consumption vs. Expenditure

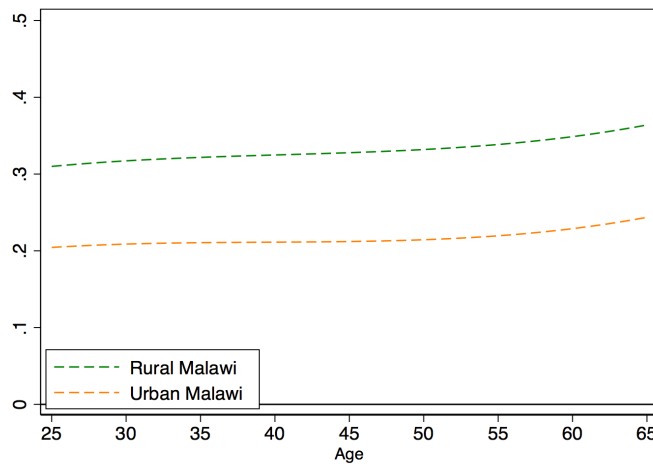
(a) Rural Malawi



(b) Urban Malawi



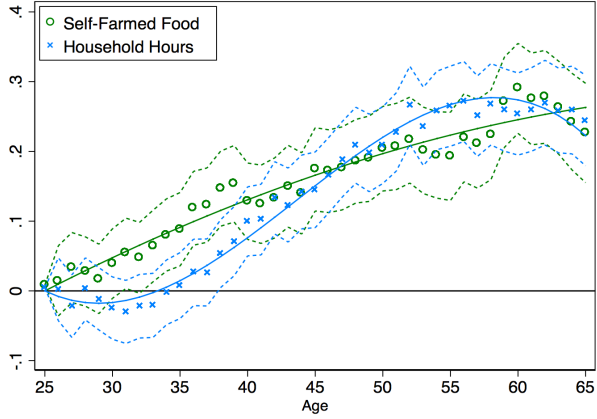
(c) Maize Share



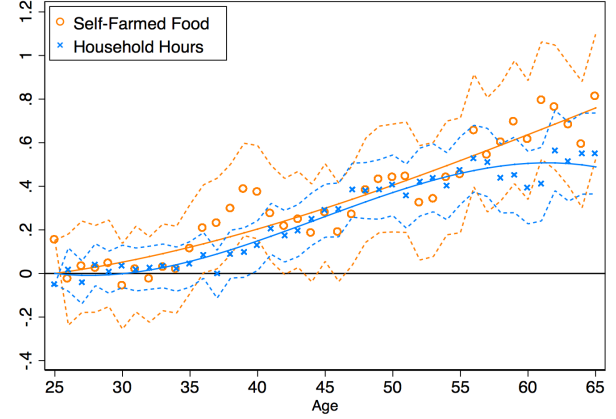
*Notes:* Consumption profiles are measured in terms of caloric intake and the quantity (kilograms) of maize consumed in rural and urban Malawi, respectively panel (a) and panel (b). In each panel, we overlay consumption with food expenditure profiles from panel (a) in Figure 3. In panel (c), we plot the expenditure share of maize out of total food expenditure. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) with 95% confidence intervals and associated cubic polynomials. The confidence intervals are based on robust standard errors. All profiles are plotted in adult-equivalent terms.

Figure 7: Self-Farming Hours and Schooling

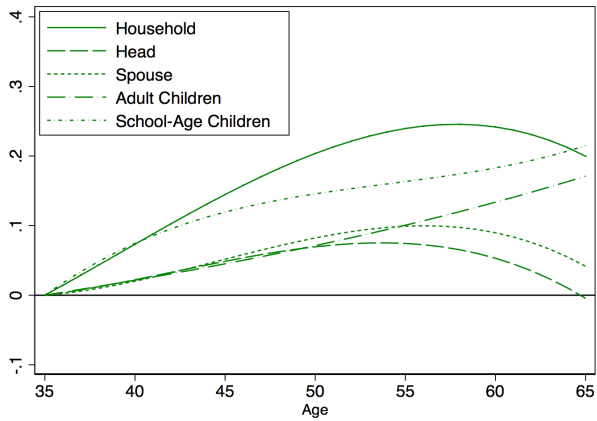
(a) Household Self-Farming Food and Hours (Rural)



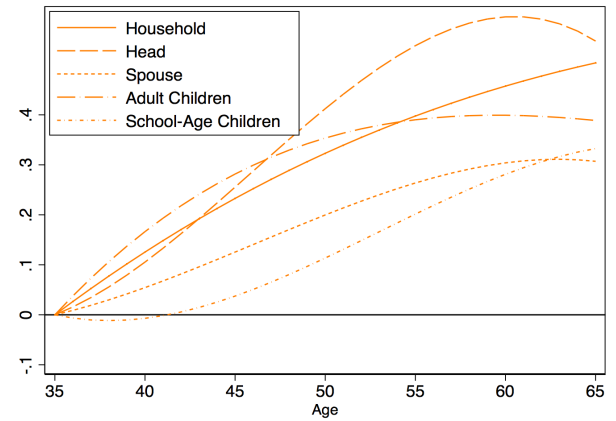
(b) Household Self-Farming Food and Hours (Urban)



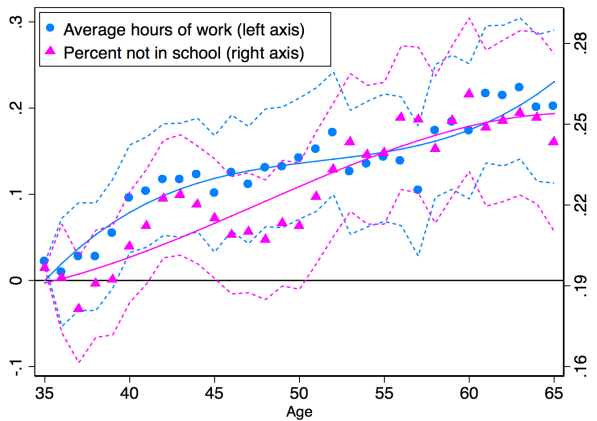
(c) Household Member Self-Farming Hours (Rural)



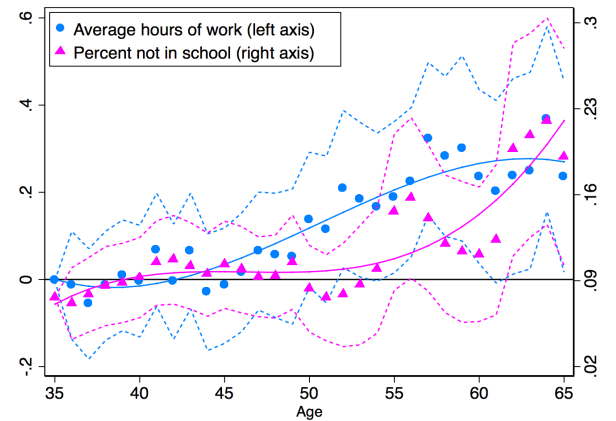
(d) Household Member Self-Farming Hours (Urban)



(e) Children Schooling and Self-Farming Hours (Rural)



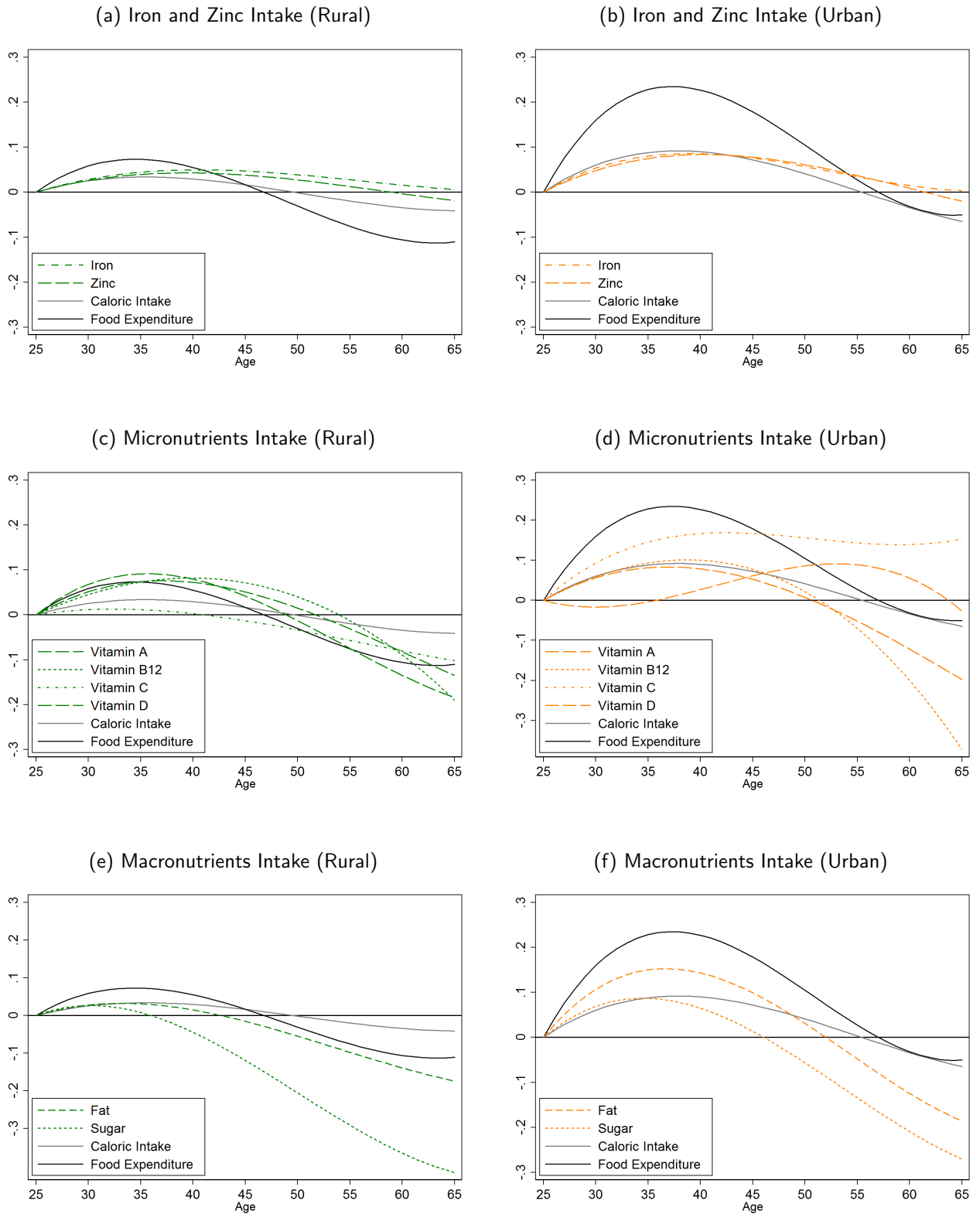
(f) Children Schooling and Self-Farming Hours (Urban)



*Notes:* The top panels show the adult-equivalent self-farmed food expenditure and adult-equivalent working hours employed in self-farming. The center panels break down the household hours employed in self-farming by household members: head, spouse, school-age children, and adult children. In the case of children, hours are in per capita terms, i.e., we divide total children hours by total number of children. The age profiles are normalized to 0 (in logs) at age 25. The bottom panels focus on school age children (6-18); we normalize log hours in per capita terms to 0 (in logs) at age 35 and show the percentage of school-age children currently not attending school. The left panels refer to rural areas in Malawi, and the right panels refer to urban areas in Malawi.



Figure 8: Quality of Lifecycle Consumption



*Notes:* We plot consumption (nutrient intake) profiles by minerals (iron and zinc) in the top panels, micronutrients (vitamins A, B12, C and D) in the center panels, and macronutrients (fat and sugar) in the bottom panels. The left panels refer to rural areas in Malawi, and the right panels refer to urban areas in Malawi. In each panel, we overlay nutrient intake with calories and food expenditure profiles from Figure 6. See our discussion in Section 4. The age profiles are normalized to 0 (in logs) at age 25. The graphs show estimated age effects (marked with dots) and associated cubic polynomials. All profiles are plotted in adult-equivalent terms.